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Potential Health Hazards from Consumption of Fish Caught in Polluted Coastal Waters of Los Angeles County

HAROLD W. PUFFER,[1] MARYSIA J. DUDA,[2] AND STANLEY P. AZEN[2]

Departments of Pathology[1] and Preventive Medicine,[2] School of Medicine
University of Southern California, Los Angeles, California 90033

ABSTRACT

A survey was carried out in the Los Angeles metropolitan coastal area during 1980 to assess fishing activity and consumption rates of fish by sport fishermen at local sites which were pollution impacted. Among the 1,059 anglers interviewed, 49% of them fish at least one time each week and, depending on species caught, between 67% and 97% of the anglers consume some or all of their fish. The most common species caught (one out of three) was the white croaker (*Genyonemus lineatus*). Because substantially large quantities of the fish eaten were caught in areas influenced by waste discharges, concern was expressed over possible health hazards to those fish consumers.

The California Department of Fish and Game carried out a major, independent sportfishing survey in Southern California in 1978 (Wine 1979). The results of that survey indicated that considerable fishing effort was expended (one million angler-trip hours per year), 75% of the catch was composed of 20 species, and one in three fish was a white croaker. No data were obtained, however, to demonstrate the amount of fish, shellfish or both consumed by this population of sport fishermen.

This paper presents the results of a 1980 survey limited to pollution-impacted sites in the Los Angeles metropolitan area to assess the consumption rates (in percent) of fish and shellfish by local anglers and to identify groups having significantly large consumption rates. The results of this study represent the first phase in the evaluation of the potential hazard by consumption of marine fish and shellfish from polluted waters in the harbor and coastal regions of Los Angeles County. The scientific names of fish mentioned in this paper are listed in Table 3.

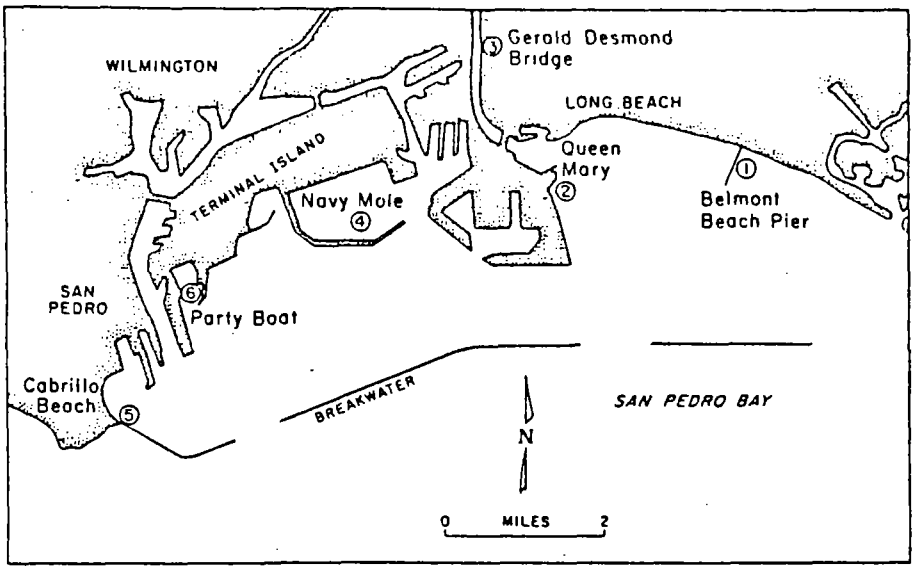
METHODS

A coded questionnaire on sportfishing and catch consumption was designed in 1979, based on several pilot tests. The questionnaire was used to collect information on: (a) demographic characteristics of the fisherman and his family/living group, (b) patterns of fishing activity, (c) species, numbers and weight of fish caught, and (d) characteristics of fish consumption in family/living group. A distinction was made between fishermen who caught fish for consumption and those who caught fish for other, non-commercial purposes.

Numerous fishing locations in the harbor and coastal areas of Los Angeles were evaluated as possible survey sites (Fig. 1). Twelve representative locations subsequently were chosen for the survey because they were well-used, contained abundant marine life, and were affected by varying degrees of pollution. Two of the sites (7 and 8) were near sewage outfalls. The major Los Angeles County piers were included in the survey (sites 1, 5, and 8–11). Party boats (sites 6 and 12) were included but private boats and shore fishermen were not.

Four interviewers visited each of the 12 sites, usually in teams of two, between January 1 and December 31, 1980. Attempts were made to survey each site approximately three times per month on different days of the week and at different times of the day. These interviewers were selected on the basis of their southern California fishing experience and knowledge of marine life. Each team was composed of a male and female and wore appropriate census identification.

When the number of fishermen with fish at the sampling site was greater than 20, a systematic sampling approach was used. Only those fish-



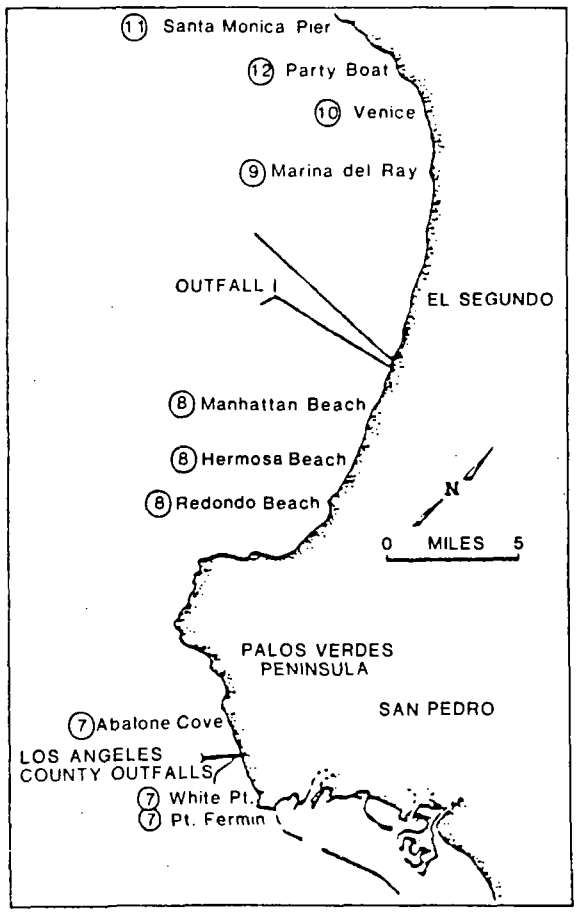


Figure 1. Creel-census sites in the coastal waters of Los Angeles County, 1980.

Table 1. Demographic profile of 1,059 interviewed anglers in the Los Angeles area.

Item	Percentage
Sex	
Male	88
Female	12
Age (years)	
≤17	11
18–40	52
41–65	28
>65	9
Race	
Caucasian	42
Black	24
Mexican-American	16
Oriental/Samoan	13
Other	5
Occupation	
Student	14
Retired	14
Employed	61
Unemployed	11
Size of family	
1	16
2	25
3–4	30
5+	29

Table 2. Percentage distribution of angling and eating fish by 1,059 interviewed anglers in the Los Angeles area.

	Percentage
Frequency of fishing in area of interview	
5–7 times/week	5
3–4 times/week	9
1–2 times/week	35
1–3 times/month	23
Infrequently (< 1/month)	28
Frequency of eating fish	
5–7 times/week	5
3–4 times/week	14
1–2 times/week	49
1–3 times/month	23
Infrequently (< 1/month)	9

ermen with fish were interviewed. No fisherman was interviewed more than once during the year.

During the interview, fish were identified, counted, and the average weight estimated using Ohaus Dial Spring scales. Photographs were taken frequently to confirm the reliability of the identification of fish and site conditions. Surveyors also coded the questionnaire for keypunching. Questionnaires were submitted to the analyst/supervisor at biweekly meetings and reviewed for accuracy, consistency, and completeness. The data were keypunched and stored in a disk file, and analyses were carried out using the SPSS computer package (Nie et al. 1975).

Results

During 1980 a total of 1,059 interviews were conducted in 400 visits to the 12 sites; 61% during the week and 39% on weekends. Nearly two-thirds of the days were sunny, but the remainder were either foggy, cloudy, or rainy. During January, mid-February, and March, heavy rains reduced the number of interviews. Heavy erosion and landslide conditions closed Abalone Cove (Site 7) from late March until November. In early spring, quarantines were imposed in Santa Monica Bay and the Los Angeles and Long Beach harbors due to heavy sewage overflow and interviews could not be obtained. Also, Gerald Desmond Bridge (Site 3), which is not legally a public access bridge, was closed in March and from mid-September to December. Illegal disposal of chemicals also caused the closure of sites 9–11 from December 9 to 17.

The demographic characteristics of the interviewed sport fishermen and their family/living groups are shown in Table 1. The majority of those interviewed were male, Caucasian, 18–40 years old, employed, and living with three or more persons.

The frequency of fishing activity and fish consumption is presented in Table 2. Approximately one-half of the fishermen fished at least once a week (more than one-half had been fishing 4 or more hours at the time of the interview) and 68% ate fish at least weekly, some as often as seven times a week.

A summary of the 12 primary fish species that were kept (i.e., not thrown back or used as bait), the median number per catch, and the average weight per species is shown in Table 3. One-third of the anglers caught white croakers, and chub mackerel were taken by 25% of the fishermen. Shellfish (primarily crabs and mussels) constituted only 3% of the catch.

In Table 4 there is a summary, by species, of the percentage of fishermen who primarily either consumed their fish or gave it away, and the principal methods of preparation. Most of the fishermen ate their fish and the most common

Table 3. The principal species of fish kept by 1,059 interviewed anglers in the Los Angeles area together with the number and mean weight (grams).

Species	Percentage of fishermen who kept a species	Median number (range)	Average weight[a]
White croaker (*Genyonemus lineatus*)	34	4 (1–40)	153 ± 3
Chub mackerel (*Scomber japonicus*)	25	4 (1–56)	334 ± 9
Pacific bonito (*Sarda chiliensis*)	18	2 (1–55)	717 ± 26
Queenfish (*Seriphus politus*)	17	2 (1–100+)	143 ± 5
Jacksmelt (*Atherinopsis californiensis*)	13	1 (1–30)	223 ± 8
Walleye surfperch (*Hyperprosopon argenteum*)	10	2 (1–21)	115 ± 5
Shiner perch (*Cymatogaster aggregata*)	7	2 (1–29)	54 ± 5
Opaleye (*Girella nigricans*)	6	2 (1–13)	307 ± 38
Black perch (*Embiotoca jacksoni*)	5	2 (1–17)	196 ± 14
Kelp bass (*Paralabrax clathratus*)	5	1 (1–7)	440 ± 61
California halibut (*Paralichthys californicus*)	4	1 (1–4)	1,752 ± 144
Shellfish (*Cancer, Haliotis, Mytilus californianus*)	3	3 (1–84)	421 ± 124

[a] ±One standard error.

method of preparation was pan frying. Few fishermen ate raw fish but 8% said they ate it occasionally. Of the raw fish consumed, 16% were white croaker, 32% were Pacific bonito and 12% were chub mackerel. Other uses of fish included pet food and fertilizer.

Consumption rates of the four most commonly kept species of fish by anglers (stratified by sex, age, race, occupation, and avidity) are presented in Table 5. Anglers who were retired (older than 65 years) consumed significantly less white croaker and Pacific bonito. Also, Caucasians consumed significantly less fish than did non-Caucasians. There were no statistically significant differences in consumption rates between frequent and infrequent sport fishermen.

Discussion

The results of this study showed that there exists a regular fishing population along the southern California shoreline near Los Angeles. Of 1,059 anglers interviewed, 49% fish at least once a week, even at sites influenced by waste discharges (sites 7 and 8). The catch was dominated by a few species (Table 3) including two (white croaker and Pacific bonito) that have been found to accumulate trace organics including PCB's.[3] Eighty-two percent of the anglers consumed white croaker and 77% consumed Pacific bonito (Table 4). Of those respondents who consumed white croaker, 64% used pan frying as the primary method of cooking; 33% pan fried

[3] Data on PCB concentrations for Pacific bonito (average = 0.31 ppm) were obtained in 1975–1977 from fish taken by trawl in waters near this creel-survey area. Data on PCB concentrations for white croaker were obtained in 1979 from fish taken in the outer Los Angeles harbor region of Cabrillo Beach (average = 0.6 ppm).

Table 4. Consumption rates of fish captured by 1,059 interviewed anglers in the Los Angeles area together with primary cooking method.

Species	Consumption rate (percent)	Primary cooking method (percent)				
		Deep fry	Pan fry	Bake and charcoal broil	Raw	Other[a]
White croaker	82	19	64	12	0	5
Chub mackerel	74	10	41	28	0	21
Pacific bonito	77	5	33	43	2	17
Queenfish	79	15	70	6	1	8
Jacksmelt	78	17	57	19	0	7
Walleye surfperch	83	12	69	6	0	13
Shiner perch	67	11	72	8	0	11
Opaleye	87	16	56	14	0	14
Black perch	89	18	53	14	0	15
Kelp bass	78	12	55	21	0	12
California halibut	86	13	60	24	0	3
Shellfish	97	0	0	0	0	100

[a] Boil, soup, steam, stew.

Table 5. Consumption rates of four most common species of fish captured by 1,059 interviewed anglers, stratified according to sex, age, race, occupation, and avidity.

Item	Consumption rate (percent)			
	White croaker	Pacific mackerel	Pacific bonito	Queenfish
Sex				
Male	81	76	81	77
Female	85	84	84	93
Significance of differences	NS[a]	NS	NS	$P < .05$
Age				
<17	100	70	71	72
18–40	79	78	79	78
41–65	80	83	82	69
>65	72	68	53	89
Significance of differences	$P < .05$	NS	$P < .001$	NS
Race				
Caucasian	65	71	65	67
Black	85	100	80	75
Mexican/American	94	82	80	82
Other[b]	85	83	90	92
Significance of differences	$P < .001$	$P < .01$	$P < .001$	$P < .005$
Occupation				
Student	88	65	72	70
Retired	63	72	60	79
Employed	83	77	83	80
Unemployed	91	69	80	64
Significance of differences	$P < .001$	NS	$P < .001$	NS
Frequency of fishing[c]				
Frequent	81	79	81	78
Infrequent	83	70	75	82
Significance of differences	NS	NS	NS	NS

[a] NS = not significant.
[b] Samoan, Oriental, American Indian.
[c] Frequent: once a week or more; infrequent: less than once a week.

Pacific bonito (Table 4). In addition, Caucasians and retired anglers tended to have lower consumption rates for the four most frequently caught species than did other groups of anglers (Table 5).

As indicated above, two of the most frequently kept species that are eaten have been found to accumulate PCB's. PCB's have long been known to produce toxic effects after prolonged industrial exposure (Schwartz 1936; Ouw et al. 1976), and have been shown to affect children born to mothers exposed to oil contaminated by PCB's (Yoshimura 1974). PCB's also have been found in the milk of nursing mothers in Michigan (Wickizer et al. 1981). Although little is known about the effect of method of preparation on the pollutant content of the fish, Krone and Iwaoka (1981) have recently shown that pan frying increases mutagenicity. Because oils are used to prevent sticking and burning of fish while frying and because some pollutants (e.g., PCB's and BaP's) are highly fat soluble, there could be a partitioning of these pollutants during frying.

Despite what is known about the toxicity of PCB's (Cordle et al. 1978), it is not yet possible to assign a critical threshold of risk with any certainty so that the long-range public health significance of PCB contamination in humans remains unknown. We do feel, however, that sufficient data exist to warrant further studies. In particular, analyses should be done on the 12 most prevalent fish being consumed to identify and quantify possible contaminants. Effects of method of cooking on consumption level also should be examined, especially among the raw-fish eaters. Further work is needed to study other potentially affected populations. An in-depth health assessment of these people should be carried out.

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